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ABSTRACT

The design concept and initial development phases of academic information management (AIM) are discussed. The AIM concept is an attempt to serve three segments of academic management with data and models to support decision making. AIM is concerned with management and evaluation of instructional computing in areas other than direct computing (data processing/computer science), the networked and comprehensive development of classroom support systems, and cost-centered models with a focus on revenues and expenses. The initial effort will be the development of cost-centered models for decision support. This segment of AIM will be used by cost center managers at all levels to plan and evaluate resource allocation as well as to determine the effect of the cost center's operation. The first step is to identify the data elements that are needed (the general framework for the models), while the second step is the creation of the database. Micro-based models for decision support will also be developed. Advantages include the following: managers will have maximum decision support available with a minimal level of computer expertise required. Information management in business and industry is discussed as background. (Author/SW)

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ACADEMIC INFORMATION MANAGEMENT -- A NEW SYNTHESIS

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ABSTRACT

Management in colleges and universities suffers from a general lack of decision support tools which provide decision makers with relevant, timely, activity centered information. While some segments of management in some institutions are using quantitative tools for modeling and decision support, the ability to extract activity or cost centered information from existing data bases is far behind private sector counterpart organizations generalizing on size of institutional budget and revenue flows.

The AIM concept is an attempt to serve three segments of academic management with data and models to support decision making. The management and evaluation of instructional computing in areas other than direct computing (data processing/computer science), the networked and comprehensive development of classroom support systems, and cost centered models with a focus on revenues and expenses (including cost accounting models) are the areas of development for the AIM system. The initial effort will be directed at the development of cost centered models for decision support. This paper describes the design concept and initial development phases of the system. Actual use of the system for decision support will begin in fiscal year 1984.

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Attempts to create meaningful information for strategic planning and decision-making from data that are a byproduct of an organization's accounting records is perhaps as old as the art of accounting itself. problems of timeliness, accuracy, and relevance have led the list of reasons why sophisticated management information systems (MIS) have evolved slowly.

The rapid spread of computers to perform accounting tasks, coupled with random access mass storage, brought promise to the development of computer-based management information systems in the early 1960's. The electronic computer was capable of providing timely information, but numerous obstacles inhibitied the development of cost-effective and easy-to-use MIS systems.

First and foremost among these problems was the almost universal computer "illiteracy" prevalent among top level managers of the day. This illiteracy inhibited communication between those who needed information systems and those who could develop them. Further, the necessary data were fragmented, segregated, and generally unavailable for use in any information system which might conceivably be developed.

Harvison and Radford (1972) aptly describe this obstacle:

> Usually, when the process of data base creation starts, the operation of each component system is under the control of the manager for who it was created. He directs the updating of files and decides on the distribution of outputs. Relationships with other systems are minimal, mainly because the use for which the application was designed did not seem to require greater reference to others.

This quote describes relatively well the state of the art of information management as recently as the early 1970's. Data files were captive of the application for (and the user by) which they were created. The first widespread use of the new database technology promised a centralized source of current data which was accessible to all users. Again, however, there were barriers to the use of these data. The communication problem between the executive and their technical staff was as great as ever,

resulting in primitive database structures which were difficult to abstract or summarize quickly.

A significant factor which enhanced the development of management information systems in the late 1970's was the increasing number of young executives moving into key positions who were computer literate. These individuals, as a result, were well aware of the potential of MIS systems. Long and Brunn (1974) note, "leisurely long-range forecasting will become an increasingly insupportable luxury. Crystal balling won't become outmoded, but figuring out fast evaporating trends will involve an unmeasurable flood of ever increasing, rapidly changing variables." These statements place into perspective the change in management thinking which resulted from a rapidly advancing computer technology coupled with the educational enhancements of managers who were in positions of support to top executives.

Information Management in Business and Industry

The private sector began to capitalize on the data processing systems which were already in operation. The cost of such systems forced top management to be painfully aware of the costs of managing and manipulating information, while increased pressure for profits and productivity forced them to seek better alternatives for informed decision-making. The new cadre of computer literate managers were quick to point out the favorable return on investment which was possible with contemporary MIS systems. Relational data bases were on the horizon, and more rapid data storage and retrieval opened the way for the development of executive information systems.

Manufacturers of mainframe computers, e.g., IBM, DEC, Wang, etc., began to develop and sell mainframes which were conducive to data sharing, data base distribution, and meaningful data manipula-tion for executives. Intelligent and powerful executive workstations were developed. On-line query, graphics, and data analysis were provided--<u>if</u> the entire configuration was designed for that purpose, <u>and</u> a single manufacturer was selected to provide the system.

Rockart and Treacy (1982) cite testimony from a Chief Executive Officer who uses such a system.

> The system as been of infinite help in allowing me to improve my mental model of the company and the industry we're in. I feel much more confident that I am on top of the operations of our company and its future path.

Another CEO states:

> Frankly, a secondary but very real advantage of the use of the system by me is the signal it gives to the rest of the company that I desire more quantitatively oriented management of the organization. I want subordinates to think more analytically, and they are. I feel we're on the way to becoming a significantly better managed company.

Testimonies such as these are becoming more common among CEO's. These leaders will force the transition of systems and managers to a state of sophistication which was envisioned and predicted in the 1960's, but required the impetus of the "capital whip" to make it a reality.

The past several years have witnessed a new direction in the evolution of the MIS or EIS (Executive Information System). The rapid spread of microcomputer technology and associated software has given rise to a new breed of information user, who range from warehouse managers to CEO's. Relatively inexpensive hardware, coupled with an amazing variety of "user friendly" software, has fostered a literal explosion in the use of computing by a broad spectrum of personnel. Moreover, every conceivable type of organization, ranging from sports teams to corporate think tanks, has discovered the advantages of using computers to manage and manipulate their valuable information.

Despite these notable advances, a number of obstacles to efficient information management remain. Most new microcomputer applications can be described as (1) being supported on a variety of microcomputer hardware within a single firm; (2) begin run on a variety of micro-operating systems due to the variety of hardware; (3) being used on data elements which are keyed by the user of the model; and (4) not being widely shared between users within an organization. This type of computer modeling for management decisions could be termed "closet computing" due to the fragmented nature of users and their applications.

In many ways, the "closet computing" done by managers today is not unlike the departmental computing done by data processing departments of the 1960's and early 1970's. Its virtue lies in the fact that it is doing a better job of providing input for decision making than previous methods. The problems, however, lie in the segmented nature of the applications which open the door to errors such as data inaccuracy, poor algorithm development, relational oversights, and the obvious duplication of applications and effort.

Certainly, not all MIS or EIS systems have these defects. Some of the best systems are characterized by executive work stations which are upward and downward compatible with the host mainframe computer. DEC and Wang offer personal computers which are integral parts of their system networks, and IBM offers a number of intelligent terminal options and will probably

integrate their Personal Computer with most of their product line.

Users who are not wealthy or fortunate enough to have a fully integrated MIS network can at least standardize their microcomputers and associated software so that: (1) standard data base interfaces can provide the needed data elements or aggregation of elements; and (2) standard spreadsheet algorithms can be shared throughout the organization so that executives are studying models built with the same assumptions. This would leave the MIS group with only the responsibility of maintaining the data base and necessary extracts to support the network.

Stibbens (1982) quotes an MIS director as saying:

> Control? I'm not concerned about having total control. I'm concerned more with everybody working off the same set of data. I'd rather be the keeper of the data and let everybody take copies to reformat it or do whatever they want but always come back to my organization for the raw data. Then we have only one place to go to keep it up-to-date.

Clearly, then the key concept is sharing common data and common assumptions about the nature of those data. The most successful MIS or EIS systems will feature the sharing of information and algorithms. This sharing is irrespective of whether the systems are based on a single vendor's compatible hardware or whether there is some common hardware standard imposed by the organization. Either approach will bring management based computing "out of the closet."

Information Management in Higher Education

The development of MIS in the private sector gives rise to an important question: what information management processes and quantitative methods have been employed to facilitate accurate decision-making in higher education? Herzlinger (1977) provides a relatively negative characterization.

> The state of control and information systems in non-profit organizations is dismal. Despite billions of dollars spent to provide relevant, accurate, and timely data, few non-profit organizations possess systems whose quality equals those found in large, profit-oriented corporations. Non-profit organizations do not lack data; if anything, they enjoy an over-abundance of numbers and statistics. Rather, they lack systematically provided information to help management do its job.

In the few years since Herlinger's observations, hundreds of nonprofit organizations, colleges and universities included, have necessarily changed their attitudes toward basic cost accounting. Scarce resources and decreasing enrollments in higher education have provided the catalyst for the development of MIS. In an attempt to reverse the trend towards fewer dollars resulting in poorer education, a large number of educational administrators have joined their private sector counterparts in becoming advocates of "closet computing." While not discounting the positive effects from this effort, the same difficulties which were mentioned in relation to closet computing in the private sector are and will be found in higher education.

Colleges and Universities are further hampered by the limitations on capital expenditures, which make it almost impossible to discard existing computing facilities in favor of installing a fully integrated, micro to mainframe system. This does not mean that educational institutions are in a hopeless position. Rather, it will require more of an effort by senior administration if a useful information management system for higher education is to become a reality.

The Need for an Academic Information Management System

There is no need to present a convincing argument in favor of improving the administrative decisions regarding the use of scarce resources in higher education. Books and journals are replete with articles documenting this need. None but the most heavily endowed institutions have escaped the realities of reduced funding, and few institutions can claim that they have met this challenge with better decision-making tools than were used before the crunch began. Instead, the typical reaction to reduced funding is some form of across-the-board or modified proportional funding cut for all units of the institution. Such wholesale reductions, however, take into account neither the relative import of these units to future "return on investment," nor the future vitality of the organization.

Given the lack of effective tools for information mangement, college and university administrators can hardly be blamed for not being more discriminating in their approach to resource allocation. The lack of meaningful modeling tools precludes informed decisions which are based on probability models, or which compare cost/benefit ratios in all possible permutations. In short, optimizing gives way to satisficing because there is no meaningful information from which difficult decisions can be made. The only budget cutting alternative is "everyone gives up a little." The result is that institutions move along the same path as they historically have, modified only by less of the same.

Quality of administration is perhaps the only universal solution to the "crisis" of quality in education. Massive faculty retraining or more rigorous core curricula are best viewed as cyclical in nature, while improved adminstrative

techniques are linear, and can be counted on to produce consistently better academic results brought about by more effective planning and resource allocation. The concept of optimizing decision strategies offers the promise of emulating the successes of the private sector in the context of higher education. To say that an information management system will solve all of the maintenance and development problems faced by higher education in the United States would be naive. Nevertheless, to ignore the advantages of effective information management would be to ignore the teachings which have been disseminated from the educational institutions themselves.

The AIM Concept

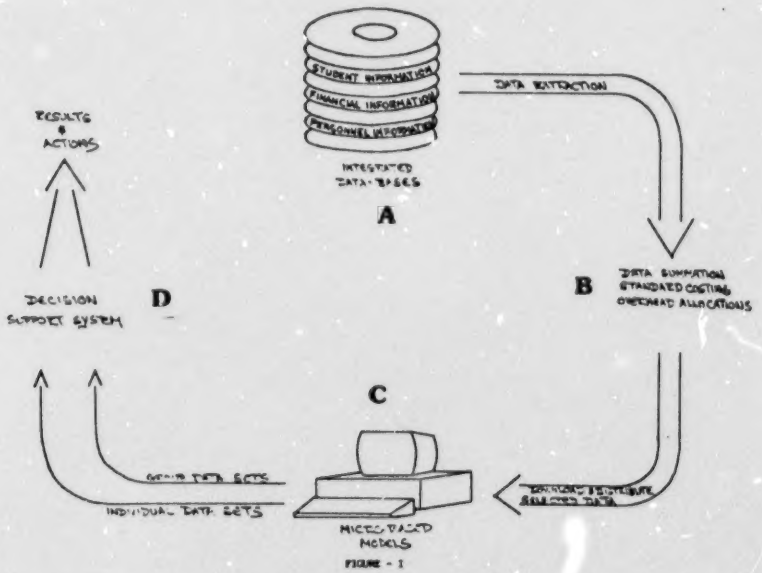

FIGURE - 1

The AIM concept is bi-directional with one goal being the complete curricular integration of computing and the other goal being the ability to focus on cost-center models for planning purposes. The curricular integration of computing targets the untouched "middle ground" of curriculum which remains largely unaffected by computing. Students are instructed in data processing or computer science principles, and make use of computers for instructional support in some physical and social science curriculum. CAI is focused in limited curricular areas, leaving much of the task of computer integration throughout the curriculum up to the student. By this I mean that the student is expected to learn computing skills in computing courses, and then apply these skills to other diciplines. The instructionally oriented part of AIM addresses these issues by greatly improving computer access to students and faculty while making possible the use of innovative classroom management tools on a widespread,

networked basis.

The cost-center modeling portion of the AIM concept will be the first to be developed. This segment of AIM, labeled EIS after it's industrial counterpart, will be used by cost center managers at all levels to plan and evaluate resource allocation as well as to determine the affect of the cost center's operation on the organization as a whole.

Figure 1 shows the relationship of an EIS to an organizations extant data base structure. This implies that the first order of business towards establishing a worthwhile EIS is to access the current state of organizational data. Time and computer operating constraints preclude the development of a time and cost-effective EIS using anything other than a data base structure to build upon. If your organization is not using data base technology, a timely and comprehensive EIS will be difficult if not impossible to achieve. In some cases, early heirarchical type data bases may present cumbersome obsticles to data base extraction and synthesis, but at least the data will be available in a composite, on-line source. The following description of the steps to be followed in the development of an EIS reference the data flow shown in Figure 1.

A. MAINFRAME DATA BASE EXTRACTS

The first step is to identify the data elements which are needed for the EIS. This means that the general framework for the models must be given consideration at this point. The organizations data element dictionary should be used to identify the required elements which will then be divided into two groups; one group representing elements for periodic extraction, the other group representing elements which must be extracted from the "live base" each time that they are used due to the need for absolute currency of data. Live data base extractions are to be discouraged unless they are absolutely necessary due to the system degrading nature of a large number of simultaneous on-line queries. Certain elements needed for models or decision support information will not be part of the "live base", yet the basic information required to compute these elements hopefully will exist. The basic elements will be extracted, the new elements computed and stored in a separate, newly created EIS data base.

B. EIS DATA BASE CREATION

The second step of the process is the creation of an EIS data base. This data base may be housed on a mainframe computer, or more ideally downloaded to a local area network mass storage unit. The idea is to provide managers access to a data base which contains all of the necessary elements for decision support without degrading the mainframe system response time.

Many of the elements for the EIS data base will have to be

computed from existing data elements by applying certain algorithms at the time of the original extract. Examples of these elements would be course enrollment history data and cost accounting data. Course history on existing data bases is usually stored by term and section. For modeling purposes this history needs to be collapsed into elements which show aggregate enrollment by course broken down by location, and time of offering (day, evening, other). Cost accounting data must be computed from existing data bases to provide the EIS data base with data elements such as standard labor costs for various categories of faculty and staff, and overhead allocations by cost center. The process of cost accounting procedure development is key to the success of an EIS - and it is a process which must be worked out in a way that satisfies the needs of the specific organization which will use the cost data for modeling.

Once the costing formulas are agreed upon, the same process for data extraction and new data element computation will be followed periodically, probably weekly, so that the EIS data base will be current within agreed upon time constraints. Cost breakdowns which are in greater detail than cost center (breaking overhead allocations down to the course level) is best done at the micro-model stage of the process.

C. MICRO-BASED MODELS

The primary conditions underlying the development of micro-based models for decision support is that they: (a) draw upon a centralized EIS data base to insure data integrity and access speed; (b) utilize commercially available software for the actual modeling task. The only limitations on micro software selection are the degree of suitability to the modeling task and the ability to readily accept input data from external data sources. Once a model is conceptualized and put into the proper software format the link between the model and the EIS data base will be standardized and included in the model as a macro instruction. This linking step may require some technical support to accomplish, but once it is operational the procedure will occur automatically and be transparent to the user of the model.

Some data elements will have to be key entered by the user of the model. These elements, mostly those required for the "what if" questions such as inflation rate estimates, will usually come from data sources external to the organization.

D. DECISION SUPPORT SYSTEM

The elements of AIM which are required to support a specific decision will naturally vary dependent upon the overall decision environment. At times, the support will consist of single screen queries as have been used in the past. If multiple screen queries are needed, a macro instruction to extract all of the needed data at one time will result in multiple data sets,

reformatted as needed and made available to the decision maker on a single "windowed" screen. This will eliminate the need to perform multiple queries to extract support data for a single decision. At other times, the results of models alone, or models coupled with queries will be needed.

The major advantage of the EIS system which is designed as described in this paper is that a manager will have the maximum decision support available in terms of models and data extraction with a minimal level of computer expertise required. Microcomputer operation and familiarity with the selected microcomputer software are the only requirements for use of the EIS system. Furthermore, the modeling software can be "pre-structured" by technical support staff to perform the desired tasks, so the end user of the EIS system could use the standard models which he/she helped conceptualize, or the standard models could be modified to the end user's satisfaction with the assurance that the original standardized model could always be reactivated.

CONCLUSION

The reality of decision support systems for managers of educational institutions has been hampered by a combination of funding, the state of technology, and user knowledge of system design potential. The technological limitations have been mostly removed with the development of the large capacity microcomputer, the local area network, and integrated spreadsheet type software. The EIS segment of AIM simply takes advantage of these technological breakthroughs, and combines them with modeling, simulation, operations research, cost accounting, and other managerial techniques which have long been diseminated by the very institutions which stand to profit most by the installation and use of a cost-effective and timely decision support system.

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